Radioactivity, Fission and Fusion   Name ……………

1.   The table gives information about the three types of particle that make up an atom.

Particle	Relative mass	Relative charge
Proton		+1
Neutron	1	
Electron	very small	−1

(a)   Complete the table by adding the **two** missing values.

(2)

(b)   Use the information in the table to explain why an atom has no overall electrical charge.

....

....

....

....

(2)

(c)   Uranium has two natural isotopes, uranium-235 and uranium-238.
Uranium-235 is used as a fuel inside a nuclear reactor.
Inside the reactor, atoms of uranium-235 are split and energy is released.

(i)   How is the structure of an atom of uranium-235 different from the structure of an atom of uranium-238?

....

....

(1)

(ii)   The nucleus of a uranium-235 atom must absorb a particle before the atom is able to split.

What type of particle is absorbed?

....

(1)

(iii)   The nucleus of an atom splits into smaller parts in a reactor.

What name is given to this process?

....

(1)

(Total 7 marks)

2. (a) The table gives information about the radioactive isotope, radon-222.

mass number	222
atomic number	86
radiation emitted	alpha particle

(i) Complete the following sentence.

The mass number is the total number of .... and

.... inside an atom.

(2)

(ii) Radon-222 is an isotope of radon.

How many protons are there in an atom of radon-222?

....

(1)

(iii) When an atom of radon-222 emits an alpha particle, the radon-222 changes into an atom of polonium-218.

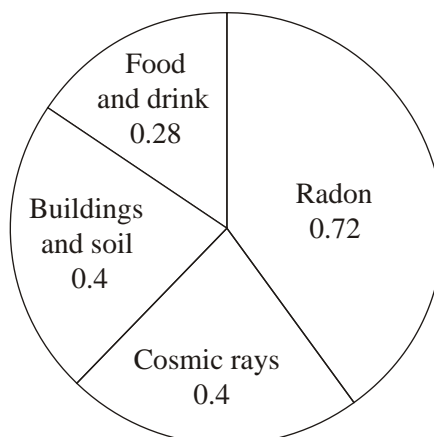An alpha particle consists of 2 protons and 2 neutrons.

How is the structure of the nucleus of a polonium-218 atom different from the structure of the nucleus of a radon-222 atom?

....

(1)

(b) The pie chart shows the average radiation dose that a person in the UK receives each year from natural background radiation.

The doses are measured in millisieverts (mSv).

(i) Calculate the proportion of natural background radiation that comes from radon. Show clearly how you work out your answer.

....

....

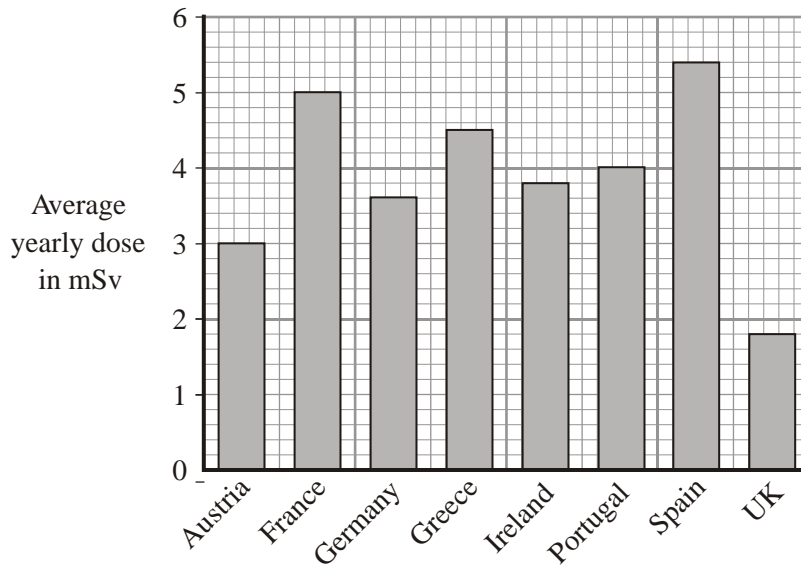Proportion of radon = ...

(2)

(ii) Not all background radiation is from natural sources.

Name **one** source of background radiation that is not natural.

....

(1)

(c) The bar chart shows the average yearly dose from natural background radiation in different European countries.

(i) How many times bigger is the average annual background dose in Germany compared to the UK?

....

(1)

(ii) The following table gives the effects of different radiation doses on the human body.

Radiation dose in mSv	Effects
10 000	Immediate illness; death within a few weeks
1 000	Radiation sickness; unlikely to cause death
50	Lowest dose with evidence of causing cancer

A family goes to Germany for a two-week holiday. Should they be concerned about the higher level of background radiation in Germany?

Draw a ring around your answer.
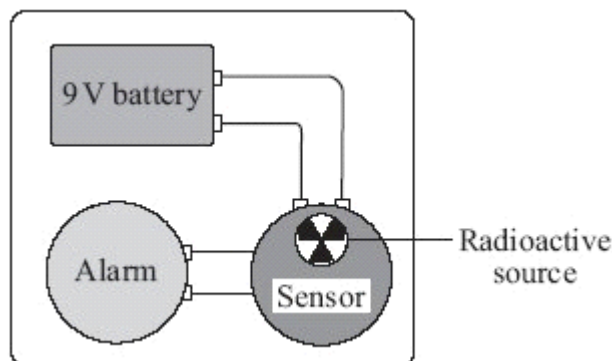
Yes   No

Explain your answer.

....

....

....

....

(2)
(Total 10 marks)

3. (a) The diagram shows the parts of a smoke detector. The radioactive source emits alpha particles.

The alpha particles ionise the air inside the sensor which causes a small electric current. Any smoke getting into the sensor changes the current. The change in current sets the alarm off.

(i)   The smoke detector would **not** work if a radioactive source that emitted only gamma rays was used.

Why not?

....

....

(1)

(ii)   Curium-242 is a radioactive isotope with a half-life of 160 days. It emits alpha particles.

Why is curium-242 **not** suitable for use inside smoke detectors?

....

....
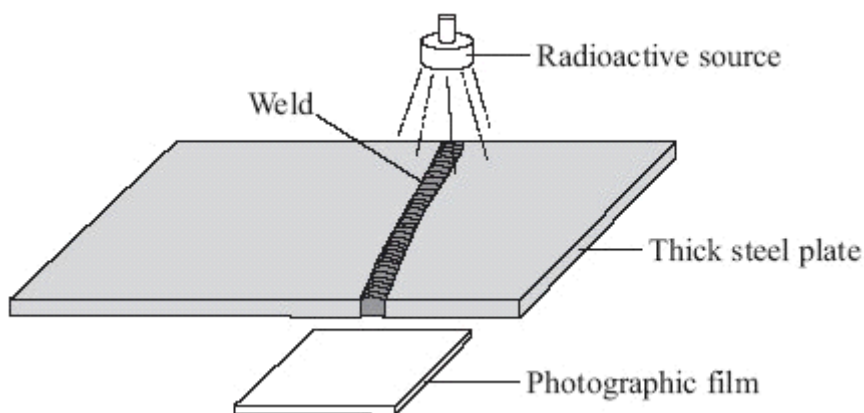
(1)

(iii) Curium-242 and curium-244 are two of the isotopes of the element curium.

How is an atom of curium-242 different from an atom of curium-244?

....

....

(1)

(b)   Sections of steel are often joined by welding them together. The diagram shows how a radioactive source can be used to check for tiny cracks in the weld.

Cracks in the weld will be shown up on the photographic film below the thick steel plate.

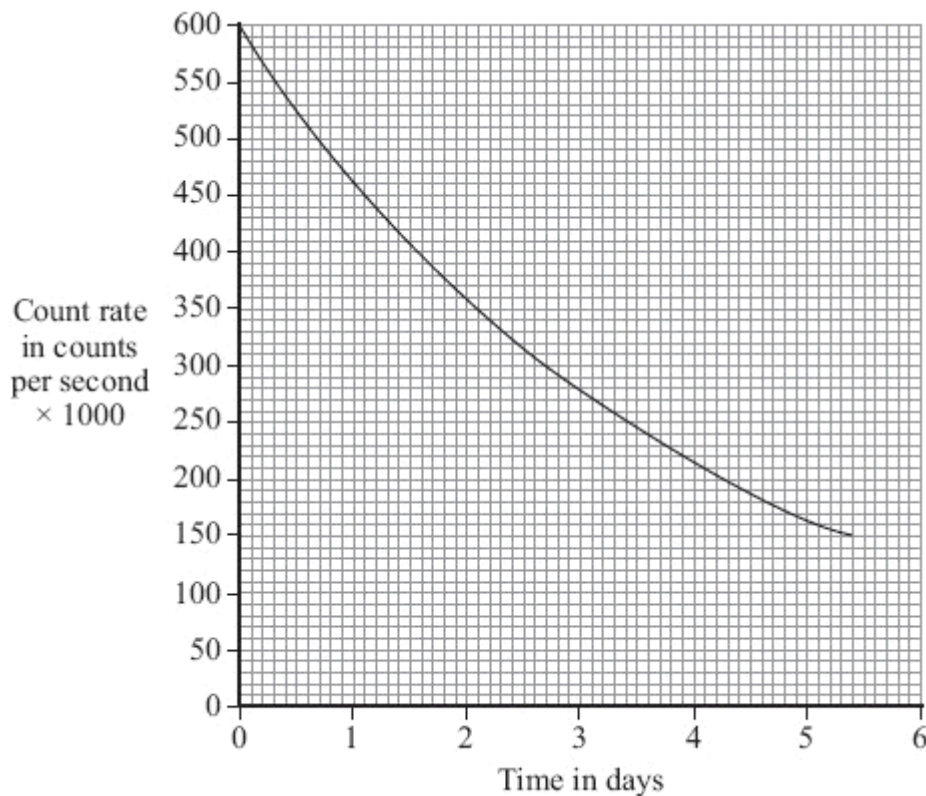(i) Which type of source, alpha, beta or gamma, should be used to check the weld?

....

(1)

(ii) Give a reason why the other two types of source **cannot** be used.

....

....

(1)

(c) The graph shows how the count rate from a sample of a different radioactive isotope, gold-198, changes with time.

Use the graph to calculate the half-life of gold-198.

Show clearly on the graph how you obtain your answer.

....

....

Half-life = ... days

(2)
(Total 7 marks)